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POTENTIAL IMPACT OF INDUSTRIAL SOLID WASTE MANAGEMENT IN ILORIN METROPOLIS

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ABSTRACT

Solid waste is an inevitable consequence of human activities on earth; hence an investigation was carried out to assess the impact of methods of solid waste management of selected industries on the environment in Ilorin metropolis. Two main tools used for the study were: a structured questionnaire and physical collection of solid wastes generated from the industries located within Ilorin metropolis. Percentages and charts were used in analysing the data. Sawmill waste recorded 98.69% out of the total weight of waste collected for the experiment. 1.04%, 0.22% and 0.04% were recorded for plastic, printing (papers) and films (publishing) industries, respectively. The results showed that 58% of the industries monitored their solid waste with 15% and 20% of PVC and sawmill industry, respectively. It was also observed that 20% of the respondents employ contractors for waste disposal, 6% deposit their waste at the dump site while 44% sell their industrial waste and 30% respondents burn their waste.

Keywords: Waste, management, solid, earth, questionnaire, environment

INTRODUCTION

Solid waste refers to all non-liquid wastes. Solid waste is the unwanted or useless solid materials generated from residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional) or contents (organic material, glass, metal, plastic paper); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious) (Ogwueleka, 2009; Zhang *et al.*, 2010).

Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. A number of processes involved in effectively managing waste include monitoring, collection, transport, processing, recycling and disposal (Chukwuemeka *et al.*, 2012). The enormous increase in the quantum and diversity of waste materials generated by industries and their potentially harmful effects on the general environment and public health have led to the urgent need to adopt scientific methods for safe management of wastes. In Nigeria the problem of solid waste management has become complex due to rapid population growth, urbanization, and industrialization and the rising standard of living. Both the quantity and diversity of waste being generated have increased. This problem is further complicated by political, economic, and sociological factors such as: bad leadership, inadequate funding, culture and individual behaviour (Agunwamba, 2003).

Most adverse environmental impacts from solid waste are rooted in the inadequate or incomplete collection and recovery of recyclable or reusable wastes, as well as disposal of hazardous wastes. These impacts are also due to inappropriate siting, design, operation, or maintenance of dumps and landfills. Improper waste management activities can: increase disease transmission or otherwise threaten public health, contaminate ground and surface water, create greenhouse gas emissions and other air pollutants, damage ecosystems, injure

people and propertyand discourages tourism and other business (Agunwamba, 1998; Lawal, 2004; Momodu *et al.*, 2011; Butu *et al.*, 2013). The general municipal waste management techniques are composting, anaerobic digestion, land filling and incineration, open dumping and uncoordinated burning of municipal solid waste. The latter is the common trends in Nigeria (Okwesili, 2016; Dimuna, 2004).

The major problem associated with industrial solid wastes handling in Ilorin metropolis includes; lack of specific disposal sites as this has encouraged indiscriminate dumping and burning of waste and location of Industries in and around residential and commercial areas. Solid waste generation in Ilorin exceeds the collection and management capacity of the Kwara State Environmental Protection Agency (KWEPA). Thousands of tonnes of solid waste are generated daily in Ilorin and most of it ends up in open dumps and wetlands, contaminating surface and groundwater and posing major health hazards (Chukwuemeka *et al.*, 2012; Akpenpuun *et al.*, 2016). This study identified the nature of industrial solid wastes (ISW) generated by selected industries within Ilorin metropolis, examine the effect of ISWmanagement decisions on greenhouse gas (GHG) emissions, establish the impact of industrial solid waste management on the environment and proffer remedial measures through management practices. The environmental benefits of an effective waste management plan include reduction or prevention of greenhouse gas emissions, reduction in the release of pollutants, conservation of resources and energy, and reduction in the demand for waste treatment landfill space.

MATERIALS AND METHODS

Study Area

Ilorin is one of the major cities in the north central zone of Nigeria. The city is located on latitudes 8º30’ and 8º50’N of the Equator and longitudes 4º20’ and 4º35’E of the Greenwich Meridian and at an altitude of about 304m above the mean sea level. Ilorin city occupies an area of about 468 sq. km and is situated in the transitional zone within the forest and the guinea savannah regions of Nigeria. Due to the small number of industries, Ilorin is classified as a semi-industrialized state (Adeniran *et al.*, 2017; Akpenpuun and Mijinyawa, 2018).

Data collection and sources

The study implemented a case study research design. Available data and information were collected from each industry (using a structured questionnaire that addressed issues such as thetype of wastes, the quantity of wastes, storage of waste, collection, and method of disposal and treatment). Seven industries in Ilorin were sampled, plastic, printing and publishing, and sawmill industries. The questionnaire was administered to waste managers, personnel and managers of industries. In addition to this, on the spot assessment of Kwara State Environmental Protection Agency (KWEPA)and personal interviews were done.

Wastes Collection and Sorting

Each industrywas visited to obtain the available firsthand information which includes the rate at which waste is generated, the amount of waste generated, waste reused, and waste compositions. Wastes generated from each industry were monitored daily over a period of 2 months, collected and sorted into different components. After sorting the wastes were weighed using a digital weighing scale

Data Analysis

Statistical Package for Social Science (SPSS) was used for the analysis of data obtained. Descriptive statistics was used to derive influences from the data obtained and bar charts, and tables are used to present the data.

RESULTS

Waste Generation Rate

The survey of waste generation by industries in Ilorin metropolis was summarised weekly in Figures 1 to 5. Results of seven industries were analysed. Four of the industries were large scale, hence they generated a large amount of wastes compare to others.

Figure 1 shows the total amount of solid wastes generated from the industries under study and it shows that the largest amount of total solid wastes was generated from the sawmill. During the period of study, the total average amount of wastes generated per week was 213000, 2267 and 329 kg for sawmill, plastic, printing and publishing industries respectively. The total quantity of wastes generated by the industries was in this order $sawmill > plastic > printingandpublishing$ industries. Wastes collected from sawmill was far more than those collected from others due to their rate of production and waste composition. The wastes comprised of sawdust, wood off-cuts and bark of log of woods.

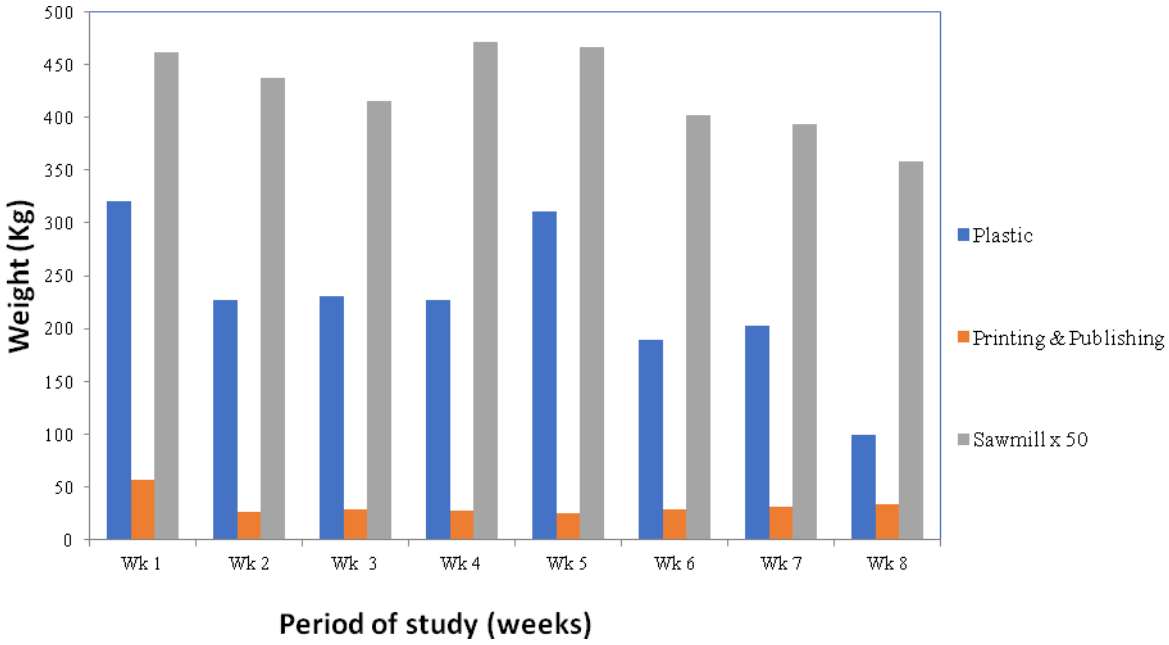

Figure 1: Total solid wastes generated from the industries under study

Figure 2 shows the quantity of PVC plastics wastes generated from the two industries considered in the study. PVC plastics wastes generated were more in PVC 1 with an average amount of 231 kg per week as compared to PVC 2 with 196 kg amount of waste. Also, PVC 1 operates with a simple extruder while PVC 2 operates with a more complex extruder. The quantity of plastic wastes is proportional to the production outcome and the kind of equipment in the production line.

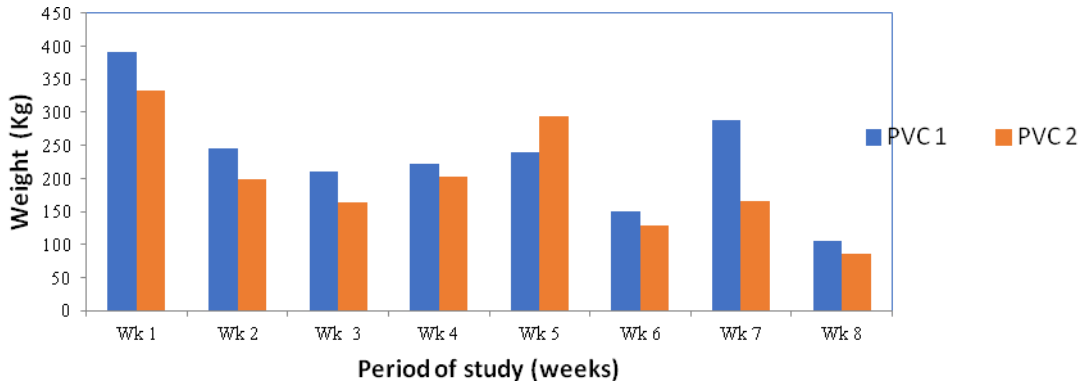

Figure 2 Plastic wastes collected from PVC industries

Figure 3 shows the quantity of wastes generated from the printing & publishing industries. PP 1 and PP 2 generated an average of 41 and 16 kg respectively. Figure 4 shows the total quantity of paper off-cut and used film generated by the printing & publishing industries. Paper off-cut accounted for 48 kg while used films accounted for 9 kg. Paper off-cut was the major wastes generated from the printing and publishing industries followed by the used films.

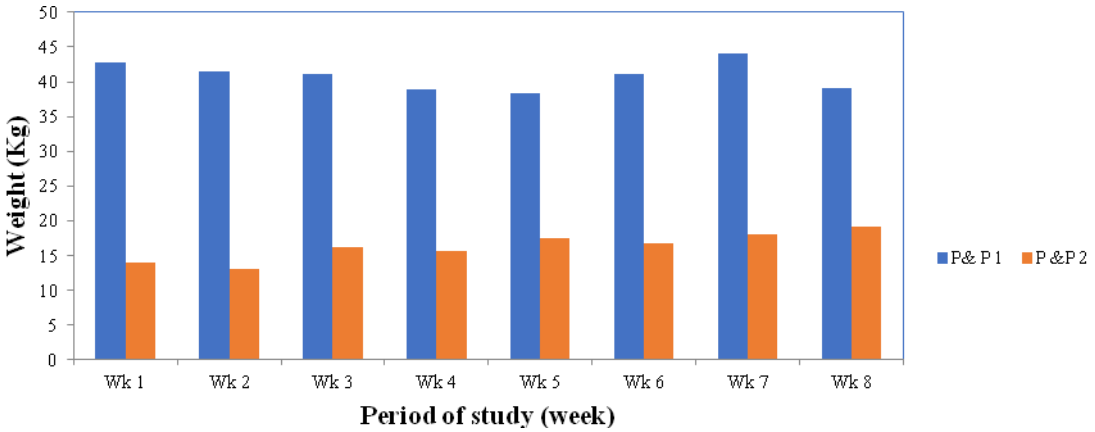

Figure 3 Solid wastes collected from Printing & Publishing Industries

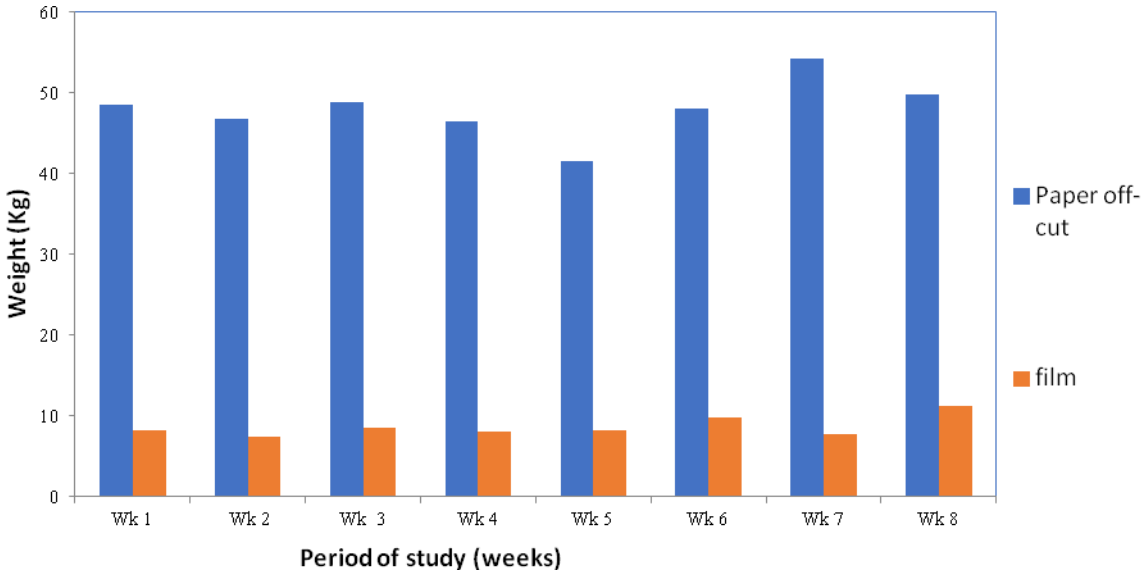

Figure 4: Total paper off-cut and used films from Printing and Publishing Industries

Figure 5 shows the quantity of wood wastes generated from the three sawmills considered in the study and that sawmill 1, sawmill 2 and sawmill 3 generated an average of 35,332, 19,925 and 8,570 kg quantity wood wastes throughout the 8-week period of study due to their scale of production. The quantity of wastes generated by sawmill followed the order sawmill 1 > sawmill 2 >sawmill 3. The composition of sawmill wastes generated in various sawmills within Ilorin metropolis is similar though there are differences in quantities and types of wastes generated.

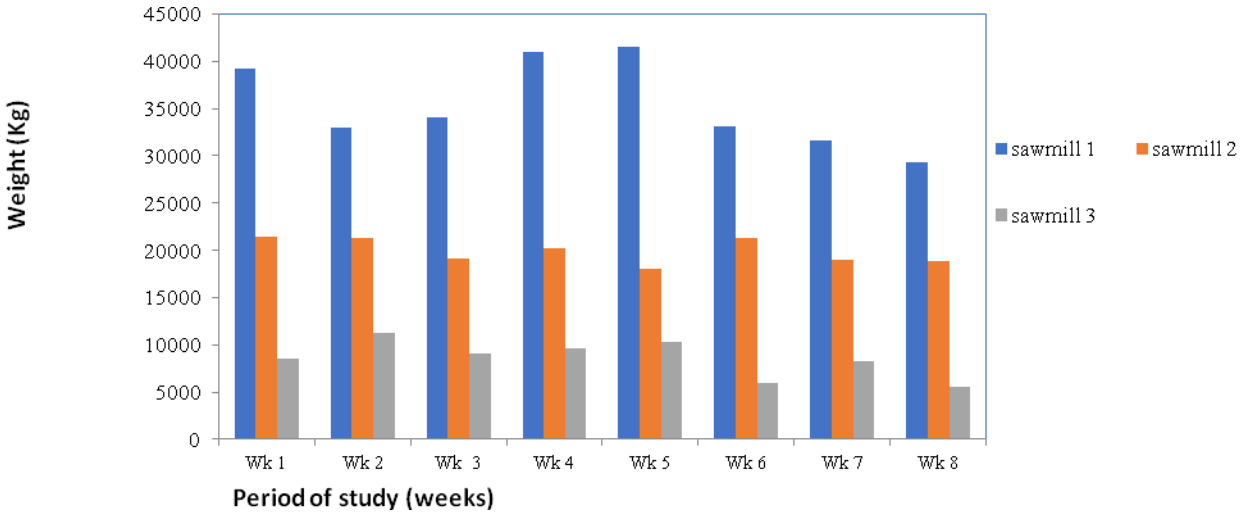

Figure 5: Solid wastes collected from sawmills

The percentage weight of the wastes generated by the industries is shown in Table 2. Surface dumping of wastes was observed to be the most prominent waste management technique employed by all the industries investigated. It was only the plastic industries that segregated generated waste before dumping. Table 3 shows the types of storage facility used by each of the industries studies.

Table 2: Types and percentage weight of solid waste generated by the industries

Major type of waste	% by weight
Plastics	226 (1.04)
Papers	48.0 (0.22)
Used films	8.65 (0.04)
Wood	21275.67 (98.69)

Table 3: Types of Storage facility used by each of the industries studies

Type of Storage	PVC N=15 (%)	Sawmill N=20 (%)	Printing press N=15 (%)	Total N=50
Uncovered Drum	8 (53.33%)	-	-	8 (16%)
Open Ground	12 (80%)	20 (100%)	9 (60%)	41(82%)
Pilled against the wall	-	-	6 (40%)	6 (12%)
Covered Bin	-	-	-	-

PVC industries employ contractors for the disposal of only 10% of generated wastes, while 20 and 40% of industries investigated deposits wastes at dump sites and sold wastes generated respectively. Sawmill and printing press industries burnt generated wastes, while the remaining wastes are dumped at dump sites some of which are illegal sites.

Table 4: Methods of Wastes Disposal

Disposal method	**Type of Industry**			
	PVC N = 15	**Saw mill N= 20**	**Printing Press N = 15**	**Total N = 50**
Waste collector contractor	10 (66.66%)	-	-	10 (20%)
Deposited at waste dump	-	-	-	3 (6%)
Sold to other industries	5(33.33)	15(75%)	2 (13.3%)	22 (44%)
Incinerating	-	-	-	-
Insitu Burning/Open Burning	-	5 (25%)	10 (66.66%)	15 (30%)

Only 60% of the industries investigated were aware of the health consequences of waste. With 66% PVC plastic, 75% sawmills, 33.3% printing press. About 44% of the industries acknowledged that their products and services are assessed for their potential to provide health, safety environment and community benefits over their life cycle while 56% acknowledged that their products and services are not assessed for their potential to provide health, safety environment and community benefits over their life cycle. From the result, Handkerchief and Respirator were provided to 26 (52%) and 8 (16%) of the respondents respectively, 64% of the respondents had a nose guard. 56.00% of the respondents had overall clothing, 15(30%) of the respondents from PVC and Sawmill industries acknowledge the use of Jungle boot. Generally, sawmill industries performed better in the provision of preventive measures.

The respondents' response to health measures available to waste managers revealed that none of the waste managers had a regular medical checkup. Respondents who had occasionally checkup were 14(28%). No formal medical checkup was recorded for 36 (72%) of the industries. Shown in Plates 1, 2 and 3 are paper cut-off, heap of sawdust and bagged wood shavings. Large quantity of wood wastes generated by the sawmills are used as firewood, bedding in poultry and bottling company.

Plate 1: Heap of sawdust

Plate 2: Paper off-cut

Plate 3: Bagged sawdust

DISCUSSION

Observations showed that waste created in printing industries in the city of Ilorin was enormous, a lot of papers, inks, darkroom chemicals, films, and plates. The quantity of waste created affects the production cost, and its disposal poses a threat to the environment. The solid wastes include empty containers, used film packages, out-dated materials, damaged plates, developed films, bad printing or spoilage, damaged product, and scrap papers. Unstable electricity current also affects the rate of wastes generated, 50% of the respondents sell their waste plates to the local aluminium pot makers. 25% use them for items such as calendar, while 25% throw them away. 66% of the respondents burn their waste films, while 20% throw them away

and 13% were collected by the cleaners for cooking. It is established in this study that paper is the most wasted material in the printing press followed by plate and films.

A mean of 71.47 m^3 (172000 kg) of wood waste was generated by the sawmills investigated in the eight weeks of the study, however, Owoyemi *et al.* (2016) reported an annual wood waste generation of 1,000,000 m^3 in 2010 by Sawmills in Nigeria, while Ogunbode, *et al.* (2013) reported an average weekly sawdust generation of 22000kg. The quantity of waste generated is dependent on patronage and stability of power supply, variation in weather condition. These data were collected during the rainy season, hence wastes generated was minimal.

The result in table 3 shows that open ground was the most prominent (82%) storage facility used by the industries followed by uncovered drum (16%). This is similar to the report of Adeniran *et al.* (2015) that the major waste disposal method employed by domestic waste collectors is dumping, while pilling against the wall accounted for about 12% of the total storage method used.

None of the industries stored their refuse in a covered bin.

An average of 71.47 m^3 (172000 kg) of wood waste generated throughout the eight weeks of the study. Owoyemi *et al.* (2016) reported that Sawmills in Nigeria generated over 1,000,000 m^3 of wood waste in 2010. The large quantity of wood wastes generated by the sawmills are sold to the surrounding community as firewood for cooking and the sawdust used by poultry owners for Bedding, bottling company and landfill. The statistics presented above shows that most of the methods used by the printing houses in disposing of the waste generated are not environmentally friendly. Ogwueleka (2009) and Ogunbode, *et al.* (2013) reported indiscriminate disposal of wastes and suggested that the inefficiencies of government agencies charged with the responsibilities of enforcing laws governing the disposal and treatment of municipal waste are the root cause of pollution resulting from indiscriminate disposal of wood waste.

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In order to dispose the ever-produced sawdust waste (as shown in Plate 2) and due to the absence of proper disposal methods of the large quantity of waste generated from sawmills in Ilorin, saw miller dispose of their wastes by open air burning and landfilled, contributing to air pollution which consequently results to climate change and global warming. Ogunwusi (2014) reported that only about 5% of total wood waste generated in Nigeria is used as raw material in other industries. This leaves a huge quantity of wood waste unutilized and this can be adduced to several factors such as; lack of incentives for wood waste utilization, inadequate information on economic returns from wood waste utilization, poor enforcement of environmental regulations, absence of policies targeted at wood waste management, lack of technical know-how on wood waste processing and utilization.

CONCLUSION

Solid waste is an inevitable consequence of human activities on earth. A large quantity of solid wastes especially sawmill wastes are being generated in Ilorin and the magnitude of the problem posed by the industries that operate in Ilorin has been identified and enumerated. Waste in the industries under study can be controlled but cannot be totally eliminated. The findings of this research reveal that a lot of waste is being created in these industries, some of which can be prevented or reduced if workers make a conscious effort to manage the waste. The study revealed that a good number of the industries had maintenance schedule program and just a small number of them did not have it, but they had other ways of making sure that their machines are in good condition for use.

Recommendations

Several social, economic and environmental benefits amass from solid waste recycling. Hence, it is recommended that:

1. Recycling be incorporated into solid waste management plans.
2. Industries compile and analyse waste data to enable continuous improvement of waste avoidance, reduction and management measures,
3. Industries evaluate the potential environmental impacts of wastes

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